

PATENT COOPERATION TREATY

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NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
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CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing: 17 May 2001 (17.05.01)	
International application No.: PCT/IL99/00600	Applicant's or agent's file reference: PDY
International filing date: 07 November 1999 (07.11.99)	Priority date:
Applicant: SHMAISER, Aron et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International preliminary Examining Authority on:
31 October 2000 (31.10.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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PATENT COOPERATION TREATY

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NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing (day/month/year)	14.09.2001
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Applicant's or agent's file reference PDY	IMPORTANT NOTIFICATION
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International application No. PCT/IL99/00600	International filing date (day/month/year) 07/11/1999	Priority date (day/month/year) 07/11/1999
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Applicant INDIGO N.V. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70) 14

Applicant's or agent's file reference PDY	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
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International Patent Classification (IPC) or national classification and IPC B41F21/12		
Applicant INDIGO N.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 31/10/2000	Date of completion of this report 14.09.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Fox, T Telephone No. +49 89 2399 2797



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL99/00600

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-12 as originally filed

Claims, No.:

1-36 as originally filed

Drawings, sheets:

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL99/00600

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims
	No:	Claims 1,3,24,25,30
Inventive step (IS)	Yes:	Claims
	No:	Claims 2, 4-23, 26-29, 31-36
Industrial applicability (IA)	Yes:	Claims 1-36
	No:	Claims

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Reference is made to the following documents:

D1: EP-A-0 616 886

D2: EP-A-0 615 941

D3: US-A-4 791 869

- V. Document D1 discloses a tandem printer (30, 40) with a mechanism for fine substrate-position correction comprising a first printing station (30) a second printing station (40), a rotatable element rotating (46) at a given rotation rate. The remaining features of claims 1 and 30 are likewise known from D1 because the rotational speed of the rotatable element (46) changes in a like manner when its angular position is corrected as in claims 1 or 30. The features of claims 3, 24 and 25 are likewise known from D1.

Document D2 also discloses all the features of claims 1, 3, 24, 25 and 30.

Consequently the subject matter of claims 1, 3, 24 and 25 is not new in the sense of Article 33(2) PCT.

The features of claims 4-9, 11, 15, 17, 21 and 31-33 have already been employed for the same purpose in a similar device or method see document D3, column 2-4. It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to a device or method according to document D1 or D2, thereby arriving at a device according to claims 4-9, 11, 15, 17, 21 and a method according to claims 31-33.

The features of claims 2, 10, 12-14, 16, 18-20, 22-29 and 34-36 are merely one of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed.

The subject-matter of claims 2-29 and 31-36 does therefore not involve an inventive step (Article 33(3) PCT).

- VII. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

Independent claims 1 and 30 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in a

preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

- VIII. According to claims 1 and 30 a controller applies a corrective step change in angular position of the rotatable element responsive to a sensor, without changing the general rotation rate of the rotatable element.

According to the described embodiments (see page 10) the rotatable element R4 is driven by a belt (26) with a constant rotation rate. When the slack between the tension pulleys changes the belt an angular displacement of the rotatable element R4. During the change of the slack the angular/circumferential speed of the rotatable element changes, i.e. the roller is accelerated or decelerated.

Consequently the general rotation rate changes.

Therefore, the embodiments of the invention in the description and shown in the figures do not fall within the scope of the claims. This inconsistency between the claims and the description leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear (Article 6 PCT).

Furthermore, the meaning of the term "without changing the **general** rotation rate of the rotatable element" is unclear, because the limits when such a change occurs are unclear.

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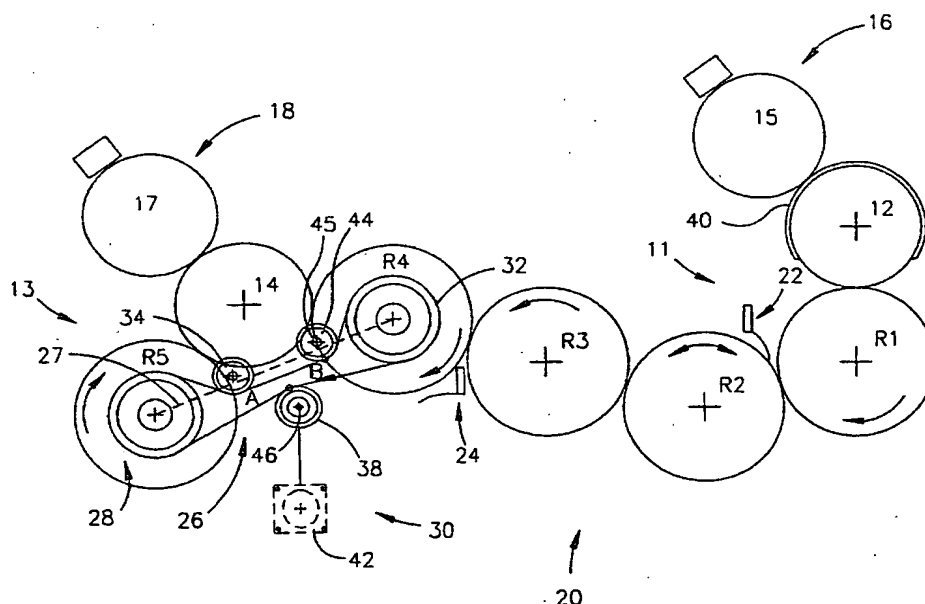
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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: **TANDEM PRINTING SYSTEM WITH FINE PAPER-POSITION CORRECTION**



(57) Abstract: A tandem printer with a mechanism for fine substrate-position correction, comprising: a first printing station; a second printing station; a rotatable element, rotating at a given rotation rate, that receives the substrate after printing thereon by the first printing station and transfers the substrate toward the second printing station; a sensor which measures the position of an edge of the substrate during its transfer from the first printing station to the second printing station; and a controller, which applies a corrective step change in angular position of the rotatable element responsive to the measurements of the sensor, without changing the general rotation rate of the rotatable element.

TANDEM PRINTING SYSTEM
WITH FINE PAPER-POSITION CORRECTION

FIELD OF THE INVENTION

The present invention relates generally to printing systems and more particularly to tandem printing systems for printing variable information using two or more printing stations and including a paper-position correction mechanism.

BACKGROUND OF THE INVENTION

Tandem printing systems, that is printing systems with two or more printing engines, are well known, both for duplex printing and for multi-colour, single-side printing, with each colour being printed with a different one of a tandem series of printing engines. Such systems are known both for conventional and electronic printing. However, such systems depend on a very accurate transmission and edge alignment of the paper.

In systems of rollers and belts, a mismatch in transmission and edge alignment may occur for various reasons. The rollers may be slightly off centre, the paper may slip or creep off its hold, there may be diameter variations, for example, because of different paper thickness and the belts may stretch as a result of heat or age. To achieve the accuracy required in tandem printing, these misalignments must be corrected.

SUMMARY OF THE INVENTION

One aspect of some preferred embodiments of the invention relates to a tandem printer with a mechanism for fine paper-position correction.

Preferably, the tandem printer has a motive system comprising a rotatable element which rotates at a given rotation rate and on which the paper is mounted, wherein a step angular displacement to the rotatable element brings the paper into alignment, without changing the rotation rate of the rotatable element.

Preferably, a paper sensor measures the position of the paper. The measurements are reported to a controller which applies the step angular displacement to the rotatable element, in addition to the continuous rotation, responsive to the measurements of the sensor.

Preferably, the motive system also comprises a flexible strip, for example, a timing belt, which transfers motion at a constant rotation rate from a driving roller to the rotatable element, wherein a step displacement to the flexible strip induces the step angular displacement to the rotatable element. The axis of the flexible strip is defined as the line connecting the centre of the rotatable element and the driving roller.

Preferably, the step displacement of the flexible strip is provided by linear motion of two pulleys located upstream and downstream of the rotatable element, wherein as one pulley

presses onto the flexible strip, requiring slack, the other pulley pulls away from the flexible strip, releasing slack. The transfer of flexible-strip slack from one pulley to the other provides the step displacement of the flexible strip.

Preferably, the tandem printer comprises means for providing the required linear motion
5 to the pulleys.

In some preferred embodiments of the invention, means for providing linear motion to the pulleys comprises a rod having two edges on which the two pulleys are mounted. The rod is preferably situated perpendicular to the axis of the flexible strip, with one pulley, at one edge, pressing against the flexible strip upstream of the rotatable element, at a first point, and the
10 other pulley, at the other edge, pressing against the flexible strip downstream of the rotatable element, at a second point. Movement of the rod up and down in a direction generally perpendicular to the axis of the flexible strip provides the required linear motion to the pulleys.

Alternatively, means for providing linear motion to the pulleys comprises a shaft on which one pulley is mounted, pressing against the flexible strip at a first point and a spring-
15 loaded device (for example, a spring-loaded piston-cylinder device) on which the other pulley is mounted, in partial compression, pressing against the flexible strip at a second point, wherein the first and second points are upstream and downstream of the rotatable element, in any order, reasonably far from any rotating elements associated with the flexible strip. Linear movement of the shaft provides the linear motion to the pulley mounted on it. The response of the spring-
20 loaded device to the release or demand in slack provides the motion of the other pulley.

Preferably, a stepper motor provides the motion for the pulleys. In some preferred embodiments an eccentric shaft is used to convert the motor motion to linear motion. Alternatively, any of a slider-crank mechanism, a piston-cylinder mechanism, or a turning-screw mechanism may be used. Alternatively still, any other method of providing linear
25 motion, known to persons versed in kinematics, may be used.

Preferably, the motor is activated by a controller which determines when the paper is out of alignment and the magnitude and direction of the misalignment.

In some preferred embodiments, the section of the flexible strip adjacent to the first point and the section of the flexible strip adjacent to the second point are parallel. For small
30 displacements, the step angular displacement of the rotatable element is symmetric for upward and downward linear displacements of the pulleys.

Preferably, the step angular displacement of the rotatable element is given as a function (which may be empirical) of the linear displacement of the pulleys. Alternatively, a lookup table is used.

In some preferred embodiments of the invention, the tandem printer comprises a duplex printer for printing on both sides of paper while inverting it. Alternatively, the tandem printer comprises a multicolour printer of single side printing, with each colour being printed with a different one of the tandem series of printing engines.

5 In some preferred embodiments of the invention, the tandem printer comprises any conventional printer, such as a printer which prints directly from plates. Alternatively, the tandem printer comprises any of a lithographic printer, an electrostatic printer, or an electronic printer.

There is thus provided, in accordance with a preferred embodiment of the invention a
10 tandem printer with a mechanism for fine substrate-position correction, comprising:

a first printing station;

a second printing station;

a rotatable element, rotating at a given rotation rate, that receives the substrate after
printing thereon by the first printing station and transfers the substrate toward the second
15 printing station;

a sensor which measures the position of an edge of the substrate during its transfer from
the first printing station to the second printing station; and

a controller, which applies a corrective step change in angular position of the rotatable
element responsive to the measurements of the sensor, without changing the general rotation
20 rate of the rotatable element.

Preferably, the sensor which measures the position of an edge of the substrate is situated
on the rotatable element.

Alternatively, the sensor which measures the position of an edge of the substrate is
adjacent to the rotatable element.

25 In a preferred embodiment of the invention, the tandem printer also comprises:

a transfer system which transfers the substrate from the first printing station to the
second printing station, in which the rotatable element is comprised;

the transfer system further comprising:

a flexible strip, travelling at a given rate and providing motion to the rotatable element,
30 wherein a corrective step displacement of the flexible strip induces the corrective step change in
angular position of the rotatable element.

Preferably, the flexible strip rotates at a constant rate.

Preferably, the flexible strip is a timing belt.

In a preferred embodiment of the invention, the tandem printer also comprises at least one pulley that provides the corrective step displacement of the flexible strip.

In a preferred embodiment of the invention, the at least one pulley comprises:

two pulleys, situated along the flexible strip, one upstream and one downstream of the rotatable element, said pulleys pressing into the flexible strip at a first point and a second point, respectively, wherein when pressure of one pulley is partially released, the other pulley takes up the thus produced slack, providing the corrective step displacement of the flexible strip.

In a preferred embodiment of the invention, the tandem printer also comprises a rod, comprising two points, to which the two pulleys are attached, one at each edge, wherein linear movement of the rod provides the motion of the pulleys into and away from the flexible strip.

Preferably, the tandem printer also includes a motion provider for the rod, comprising:

an eccentric shaft to which the rod is attached; and
a motor which provides motion to the eccentric shaft,
wherein the motor is activated by the controller.

Alternatively, the tandem printer includes a motion provider for the rod, comprising:

a slider-crank mechanism, wherein the rod is attached to the slider and moves in the same direction as the slider; and

a motor which provides motion to the slider-crank mechanism,
wherein the motor is activated by the controller.

Alternatively, the tandem printer includes a motion provider for the rod, comprising:

a piston-cylinder mechanism, wherein the rod is attached to the piston and moves in the same direction as the piston; and

a motor which provides motion to the piston-cylinder mechanism,
wherein the motor is activated by the controller.

Alternatively still, the tandem printer includes a motion provider for the rod, comprising:

a turning-screw mechanism, wherein the rod is attached to the screw and moves in the same direction as the screw; and

a motor which provides motion to the turning-screw mechanism,
wherein the motor is activated by the controller.

Preferably, the motor is a stepper motor.

In another preferred embodiment of the invention, the tandem printer also comprises:

a shaft on which one of the two pulleys is mounted, pressing against the flexible strip at a first point; and

a resilient device on which the other pulley is mounted, resiliently pressing against the flexible strip at a second point,

wherein linear movement of the shaft provides motion of the pulley at the first point, and the response of the resilient device to release or demand in slack provides motion of the pulley at the second point.

Preferably, the shaft is an eccentric shaft and including:

a motor which provides motion to the eccentric shaft,

wherein the motor is activated by the controller.

Preferably, the tandem printer also includes a motion provider for the shaft, comprising:

a slider-crank mechanism, wherein the shaft is connected to the slider and moves in the same direction as the slider; and

a motor which provides motion to the slider-crank mechanism,

wherein the motor is activated by the controller.

Alternatively, the tandem printer also includes a motion provider for the shaft, comprising:

a piston-cylinder mechanism, wherein the shaft is connected to the piston and moves in the same direction as the piston; and

a motor which provides motion to the piston-cylinder mechanism,

wherein the motor is activated by the controller.

Alternatively still, the tandem printer also includes a motion provider for the shaft, comprising:

a turning-screw mechanism, wherein the shaft is connected to the screw and moves in the same direction as the screw; and

a motor which provides motion to the turning-screw mechanism,

wherein the motor is activated by the controller.

Preferably, the motor is a stepper motor.

In a preferred embodiment of the invention, the two pulleys are substantially identical.

In a preferred embodiment of the invention, the section of the flexible strip adjacent to the first point and a section of the flexible strip adjacent to the second point are parallel to each other.

In a preferred embodiment of the invention, the tandem printer comprises a duplex printer for printing on both sides of the paper while inverting it.

Alternatively, the tandem printer comprises a multicolour printer of single-side printing, with each colour being printed with a different one of the tandem series of printing engines.

In a preferred embodiment of the invention, the tandem printer is a conventional printer which uses plates.

Alternatively, the tandem printer is an electrostatic printer.

Alternatively, the tandem printer is an electronic printer.

5 Alternatively, the tandem printer is a lithographic printer.

In a preferred embodiment of the invention, a multi-engine printer with a mechanism for fine substrate-position correction, is provided, comprising at least 3 printing engines, wherein each adjacent pair of printing engines comprises a first printing station and a second printing station, of the tandem printer described herein.

10 There is further provided, in accordance with a preferred embodiment of the invention a tandem printing method while applying a fine positional correction to a substrate, comprising:

printing on a substrate by a first printing station;

transferring the substrate from the first printing station toward a second printing station, comprising:

15 mounting the substrate on a rotatable element of a substrate-transfer system; and
moving the substrate by rotating the rotatable element at a given rotation rate;
measuring the angular position of an edge of the substrate on the rotatable element; and
applying a step angular displacement to the rotatable element, responsive to the
measurement, without changing the rotation rate of the rotatable element.

20 Preferably, rotating the rotatable element at a given rotation rate comprises rotating the rotatable element by a flexible strip; and

applying the step angular displacement to the rotatable element comprises applying a step displacement to the flexible strip.

25 Preferably, applying the step displacement to the flexible strip comprises any of a positive and negative step displacements to the flexible strip, thus inducing any of a clockwise and a counterclockwise step angular displacements to the rotatable element.

Preferably, applying the positive step displacement to the flexible strip comprises:

releasing flexible strip slack upstream of the rotatable element; and

taking up flexible strip slack downstream of the rotatable element; and

30 applying the negative step displacement to the flexible strip comprises:

releasing flexible strip slack downstream of the rotatable element; and

taking up flexible strip slack upstream of the rotatable element.

Preferably, the method also includes using a lookup table to calculate a necessary step displacement of the flexible strip in order to achieve a desired step angular displacement of the rotatable element.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more clearly understood from the following detailed description of the preferred embodiments of the invention and from the attached drawings, in which same number designations are maintained throughout the figures for each element and in which:

Fig. 1 is a schematic illustration of a tandem printer comprising a correctional mechanism for correcting a paper position, in accordance with a preferred embodiment of the invention; and

Fig. 2 is a schematic illustration of a tandem printer comprising another correctional mechanism for correcting a paper position, in accordance with another preferred embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is now made to Fig. 1 which is a schematic illustration of a tandem printer 10 having a roller assembly 20 for paper inversion and transfer and a correctional mechanism 30, in accordance with a preferred embodiment of the invention.

Preferably, tandem printer 10 comprises a first printing station 11, comprising an impression roller 12 and at least one first printing engine 16 associated with it, and a second printing station 13, comprising an impression roller 14 and at least one second printing engine 18 associated with it. In the system shown, each of printing engines 16 and 18 comprises an intermediate transfer member (ITM) 15 and 17 respectively. The image is transferred to ITM 15 or 17 and then to paper 40 on the respective impression roller. Alternatively, no ITM is used, and each of printing engine 16 and 18 comprises a photoconductive drum 15 or 17 respectively. The image is preferably formed on photoconductive drum 15 or 17 and transferred to paper 40 on the impression roller. For two side printing, one side of a paper 40 is printed while it is on impression roller 12, by first printing engine 16, and an opposite side of paper 40 is printed while it is on impression roller 14, by second printing engine 18. For multicolour, single side printing, each colour is printed with a different one of the tandem series of printing engines, such as printing engines 16 and 18.

In a preferred embodiment of the invention, roller assembly 20 inverts the paper and transfers it from impression roller 12 to impression roller 14. In a preferred embodiment of the invention, the "rollers" of roller assembly 20 are rotary arms, rather than rollers, each with

vacuum nipples that attach themselves to the paper. Generally, the nipples are evenly distributed along the length of the paper and extend through the width of it. The paper pick-off system, which removes the paper from one roller and transfers it to the other, comprises a vacuum pick-off system, as one set of nipples lets go and the other takes over. The rotary-arm
5 "rollers" and the vacuum nipples and vacuum paper pick-off system associated with them are described in PCT patent application, PCT/IL98/00553, "Printing System" filed on Nov. 11, 1998, in the Israel receiving office, whose disclosure is incorporated herein by reference. Alternatively, conventional rollers may be used. The exact configuration of the paper transfer and (or) inversion system may differ from that shown, since the inversion is applicable to many
10 transfer/inversion and perfecta or perfecta-like systems known in the art.

Typically, after the first image (which may be coloured or black and white) is transferred onto the first side of paper 40, paper 40 is transferred from impression roller 12 to a roller R1 of assembly 20. From roller R1, which rotates in a clockwise direction, paper 40 is transferred to a perfecting roller R2, which, during the transfer from roller R1 to roller R2,
15 rotates in the counterclockwise direction.

Preferably, perfecting roller R2 is controlled by a servo motor (not shown) capable of moving at different angular velocities, clockwise and counterclockwise. Preferably, the purpose of perfecting roller R2 is to invert the paper. Additionally, perfecting roller R2 corrects the position of paper 40 for the following reason: Impression rollers 12 and 14 are each controlled
20 by a separate engine and slight errors are introduced by a system that controls their relative rotation. Perfecting roller R2 corrects for slight variations in angular velocities and in phases, responsive to measurements of a first paper sensor 22 which senses the position of the leading edge of paper 40 (before inversion). An error of 1-2 mm in the position of the paper may be encountered and corrected by the servo motor using the following method:

25 After receiving paper 40, servo-controlled roller R2 changes its direction to clockwise, and changes its velocity to correct for any error in the position of paper 40, bringing the trailing edge of paper 40 exactly to a pick-up point of a roller R3, rotatable counterclockwise.

As roller R3 picks up the trailing edge of paper 40, the trailing edge becomes the new leading edge, and paper 40 is inverted. It is noted that the paper is still referenced to its original
30 leading edge.

The next transfer, from roller R3, rotatable counterclockwise to a roller R4, rotatable clockwise, involves a second paper sensor 24 which determines the position of the new trailing edge (previous leading edge) of paper 40, close to the transfer point from R3, as it is transferred onto roller R4. Second paper sensor 24 may be situated on roller R4 or it may be adjacent to

roller R4. From roller R4, the paper is transferred to impression roller 14. Exact synchronisation between the image on impression roller 14 and paper 40 cannot be performed when paper 40 reaches impression roller 14; in general, the image is already on ITM (or photoconductive drum) 17 to produce an image on the second side of paper 40 when it reaches impression roller 14 at a precise time and angular position of impression roller 14. Thus, any correction in synchronisation must be made to the position of paper 40 before it reaches impression roller 14.

In the following discussion, the term pulley, as used here, refers to a wheel, possibly with a grooved rim, in direct contact with the flexible strip, preferably, a timing belt, to drive it, or to be driven by it. The term tension pulley refers to a wheel, possibly with a grooved rim, in direct contact with the flexible strip, to keep the flexible strip under tension. Preferably, roller R4 and a roller R5 are in communication with each other through a flexible strip 26, wherein a driving pulley 28 is mounted on roller R5 and moving continuously with it at a constant rotation rate, and a driven pulley 32 is mounted on roller R4 and moving continuously with it at the same (or proportional) constant rotation rate as that of R5. As used herein, the generic term flexible strip means a smooth belt, or a timing belt, or a cable, or a bead cable, or an endless chain. The term pulley may mean a sprocket

An axis 27 of flexible strip 26 is defined as the line connecting the centres of R4 and R5. A tension pulley 34 serves as a tension to flexible strip 26. (Tension pulley 34 is optional, and may be eliminated.) Alternatively, two or more tension pulleys 34 may be used.) Correctional mechanism 30 is associated with flexible strip 26 and roller R4. Note that correction mechanism 30 does not affect roller R5, the driver, since the motion of roller R5 is controlled by a driving mechanism (not shown), which is commonly driven by, or synchronously driven with impression rollers 14 and/or 12, at a constant rotation rate. Only driven pulley 32 of roller R4 is free to respond to corrections.

Preferably, correctional mechanism 30 comprises a correctional tension pulley 38, mounted on an shaft 46. Motion is provided by a stepper motor 42, which moves shaft 46 and correctional tension pulley 38 so that they travel up or down a specific amount. At an "equilibrium position", correctional tension pulley 38 presses against flexible strip 26 at a first point, downstream of roller R4, producing an indentation in the profile of flexible strip 26. A tension pulley 44 mounted on a spring-loaded device 45 in partial compression, presses against flexible strip 26 at a second point, upstream of roller R4, and produces a second indentation in the profile of flexible strip 26. Spring loaded device 45 may be a spring-loaded piston-cylinder

device. Alternatively, another spring-loaded device may be used. Alternatively, another method of resiliently pressing tension pulley 44 against flexible strip 26 may be used.

Preferably, when second paper sensor 24 determines that a positional correction to paper 40 is required, the controller activates stepper motor 42 which drives shaft 46 and correctional tension pulley 38. Step angular displacement of roller R4 is provided as follows:

When shaft 46 moves up, pressing correctional tension pulley 38 deeper against flexible strip 26 at the first point, downstream of roller R4, a demand for slack at the first point is created. In response, spring-loaded device 45 on which tension pulley 44 is mounted, compresses, pulling tension pulley 44 away from flexible strip 26 and releasing the slack that is needed downstream. Flexible strip 26 moves in a clockwise direction, producing a step angular displacement to roller R4 in the clockwise direction.

When shaft 46 drives correctional tension pulley 38 away from flexible strip 26, slack in flexible strip 26 is created at the first point, downstream of roller R4. Spring compression of spring-loaded device 45 is released somewhat; tension pulley 44 presses deeper against flexible strip 26 at the second point, gathering the slack that was released downstream. Flexible strip 26 moves a step in a counterclockwise direction, producing a step angular displacement to roller R4 in the counterclockwise direction. Note that the pressure of spring-loaded tension pulley 44 on flexible strip 26 is such that pulley 38 is always in contact with flexible strip 26. Note also that the situation described may be reversed; pulley 38 may be spring loaded or otherwise resiliently pressed against flexible strip 26 and tension pulley 44 may be driven by shaft 46.

Reference is now made to Fig. 2 which is a schematic illustration of a tandem printer 60 having a roller assembly 20 for paper inversion and transfer and another correctional mechanism 50, in accordance with another preferred embodiment of the invention.

In Fig. 2, the step linear displacement of flexible strip 26 is provided by two correctional tension pulleys 48 and 52, mounted on the two ends of a rod 54 and connected to a shaft (not shown) which is driven by stepper motor 42. Rod 54 is situated inside flexible strip 26, perpendicular to axis 27, with correctional tension pulleys 48 and 52 pressing against flexible strip 26 at two points, A and B, upstream and downstream of roller R4.

Preferably, step angular displacement of roller R4 is provided as follows:

When rod 54 moves up or down, one or the other of correction pulleys 48 or 52 is pressed deeper against flexible strip 26, requiring more slack, while the other is pulled away from flexible strip 26, releasing slack. The transfer of slack provides the step displacement of flexible strip 26, in the direction of the increased indentation, producing a step angular displacement to roller R4 in that direction.

In some preferred embodiments of the invention, as shown, correctional tension pulleys 48 and 52 are external to flexible strip 26. Alternatively, they are internal to flexible strip 26. Note that pulleys 48 and 52 are always in contact with flexible strip 26. In some preferred embodiments of the invention, two tension pulleys 34 are used. Alternatively, only one tension pulley 34 is used. Alternatively still, no tension pulley is used.

The following discussion applies to the embodiments of both Figs. 1 and 2.

Preferably, the step angular displacement of roller R4 is given as a function (which may be empirical) of the linear displacement. Alternatively, the step angular displacement of roller R4 is determined from a lookup table.

In some preferred embodiments, the section of the flexible strip adjacent to the first point and the section of the flexible strip adjacent to the second point are parallel.

For some configurations, small step angular displacements of roller R4 are symmetric for upward and downward displacements of tension pulleys 38 and 44 or tension pulleys 48 and 52. More generally, they are not.

Preferably, there is only one sheet of paper on roller R4 at any time. Preferably, the total travel time of paper 40 on roller R4 is about 0.4 - 0.5 seconds, and the order of magnitude of the correction time by correctional mechanism 30 is 0.05 - 0.1 seconds. Preferably, the order of magnitude of the positional correction of paper 40 by correctional mechanism 30 is about 0.5 mm.

In some preferred embodiments, roller assembly 20 comprises more rollers or fewer rollers, depending on the distances between impression roller 12 and impressions roller 14.

In some preferred embodiments, a multi-printing system, comprising more than two printing engines, may be used, wherein a correctional mechanism such as correctional mechanism 30 or correctional mechanism 50 is positioned between any two adjacent printing engines.

In some preferred embodiments an eccentric shaft is used to convert the motion of stepper motor 42 to linear motion. Alternatively, any of a slider-crank mechanism, a piston-cylinder mechanism, or a turning-screw mechanism may be used. Alternatively still, any other method of providing linear motion, known to persons versed in kinematics, may be used.

In some preferred embodiments of the invention, as shown in Figs. 1 and 2, the tandem printer comprises a duplex printer for printing on both sides of paper while inverting it. Alternatively, the tandem printer comprises a multicolour printer of single side printing, with each colour being printed with a different one of the tandem series of printing engines. Where the tandem printer is a multicolour printer of single side printing, perfecting roller R2 and first

paper sensor 22 are eliminated as the paper is not inverted. Alternatively, an additional roller (not shown) is provided and an operator may choose, preferably, with a keystroke at a control panel, whether to invert the paper, wherein the paper then passes through perfecting roller R2, or not to invert the paper, wherein the paper then passes through the additional roller.

5 In some preferred embodiments of the invention, the tandem printer comprises any conventional printer, such as a printer which prints directly from plates. Alternatively, the tandem printer comprises any of a lithographic printer, an electrostatic printer, or an electronic printer.

10 The present invention has been described using non-limiting detailed descriptions of preferred embodiments thereof that are provided by way of examples and are not intended to limit the scope of the invention. Variations of embodiments described will occur to persons of the art. Similarly, combinations of features of different embodiments within the scope of the claims will occur to persons of the art. These are still within the scope of the invention. The terms "comprise," "include," and "have" or their conjugates, when used herein, mean "including
15 but not necessarily limited to." The scope of the invention is limited only by the following claims:

CLAIMS

1. A tandem printer with a mechanism for fine substrate-position correction, comprising:
 - a first printing station;
 - 5 a second printing station;
 - a rotatable element, rotating at a given rotation rate, that receives the substrate after printing thereon by the first printing station and transfers the substrate toward the second printing station;
 - a sensor which measures the position of an edge of the substrate during its transfer from
 - 10 the first printing station to the second printing station; and
 - a controller, which applies a corrective step change in angular position of the rotatable element responsive to the measurements of the sensor, without changing the general rotation rate of the rotatable element.
- 15 2. A tandem printer according to claim 1 wherein the sensor which measures the position of an edge of the substrate is situated on the rotatable element.
3. A tandem printer according to claim 1 wherein the sensor which measures the position of an edge of the substrate is adjacent to the rotatable element.
- 20 4. A tandem printer according to any of claims 1-3 and comprising:
 - a transfer system which transfers the substrate from the first printing station to the second printing station, in which the rotatable element is comprised;
 - the transfer system further comprising:
 - 25 a flexible strip, travelling at a given rate and providing motion to the rotatable element, wherein a corrective step displacement of the flexible strip induces the corrective step change in angular position of the rotatable element.
5. A tandem printer according to claim 4 wherein the flexible strip rotates at a constant
- 30 rate.
6. A tandem printer according to claim 4 or claim 5 wherein the flexible strip is a timing belt.

7. A tandem printer according to any of claims 4-6 and comprising at least one pulley that provides the corrective step displacement of the flexible strip.

8. A tandem printer according to claim 7, wherein the at least one pulley comprises:

5 two pulleys, situated along the flexible strip, one upstream and one downstream of the rotatable element, said pulleys pressing into the flexible strip at a first point and a second point, respectively, wherein when pressure of one pulley is partially released, the other pulley takes up the thus produced slack, providing the corrective step displacement of the flexible strip.

10 9. A tandem printer according to claim 8 and comprising:

a rod, comprising two points, to which the two pulleys are attached, one at each edge, wherein linear movement of the rod provides the motion of the pulleys into and away from the flexible strip.

15 10. A tandem printer according to claim 9 and including a motion provider for the rod, comprising:

an eccentric shaft to which the rod is attached; and
a motor which provides motion to the eccentric shaft,
wherein the motor is activated by the controller.

20 11. A tandem printer according to claim 9 and including a motion provider for the rod, comprising:

a slider-crank mechanism, wherein the rod is attached to the slider and moves in the same direction as the slider; and

25 a motor which provides motion to the slider-crank mechanism,
wherein the motor is activated by the controller.

12. A tandem printer according to claim 9 and including a motion provider for the rod, comprising:

30 a piston-cylinder mechanism, wherein the rod is attached to the piston and moves in the same direction as the piston; and

a motor which provides motion to the piston-cylinder mechanism,
wherein the motor is activated by the controller.

13. A tandem printer according to claim 9 and including a motion provider for the rod, comprising:

a turning-screw mechanism, wherein the rod is attached to the screw and moves in the same direction as the screw; and

5 a motor which provides motion to the turning-screw mechanism,
wherein the motor is activated by the controller.

14. A tandem printer according to claims 10-13 wherein the motor is a stepper motor.

10 15. A tandem printer according to claim 8 and comprising:

a shaft on which one of the two pulleys is mounted, pressing against the flexible strip at a first point; and

a resilient device on which the other pulley is mounted, resiliently pressing against the flexible strip at a second point,

15 wherein linear movement of the shaft provides motion of the pulley at the first point, and the response of the resilient device to release or demand in slack provides motion of the pulley at the second point.

16. A tandem printer according to claim 15, wherein the shaft is an eccentric shaft and including:

20 a motor which provides motion to the eccentric shaft,
wherein the motor is activated by the controller.

17. A tandem printer according to claim 15 and including a motion provider for the shaft, comprising:

a slider-crank mechanism, wherein the shaft is connected to the slider and moves in the same direction as the slider; and

a motor which provides motion to the slider-crank mechanism,
wherein the motor is activated by the controller.

18. A tandem printer according to claim 15 and including a motion provider for the shaft, comprising:

a piston-cylinder mechanism, wherein the shaft is connected to the piston and moves in the same direction as the piston; and

a motor which provides motion to the piston-cylinder mechanism,
wherein the motor is activated by the controller.

19. A tandem printer according to claim 15 and including a motion provider for the shaft,
5 comprising:

a turning-screw mechanism, wherein the shaft is connected to the screw and moves in
the same direction as the screw; and

a motor which provides motion to the turning-screw mechanism,
wherein the motor is activated by the controller.

10 20. A tandem printer according to claims 16-19 wherein the motor is a stepper motor.

21. A tandem printer according to any of claims 8-19 wherein the two pulleys are
substantially identical.

15 22. A tandem printer according to any of claims 8-21, wherein the section of the flexible
strip adjacent to the first point and a section of the flexible strip adjacent to the second point are
parallel to each other.

20 23. A tandem printer according to any of claims 1-22, wherein the tandem printer comprises
a duplex printer for printing on both sides of the paper while inverting it.

24. A tandem printer according to any of claims 1-22, wherein the tandem printer comprises
a multicolour printer of single-side printing, with each colour being printed with a different one
25 of the tandem series of printing engines.

25. A tandem printer according to any of claims 1-24, wherein the tandem printer is a
conventional printer which uses plates.

30 26. A tandem printer according to any of claims 1-24, wherein the tandem printer is an
electrostatic printer.

27. A tandem printer according to any of claims 1-24, wherein the tandem printer is an
electronic printer.

28. A tandem printer according to any of claims 1-27, wherein the tandem printer is a lithographic printer.

5 29. A multi-engine printer with a mechanism for fine substrate-position correction, comprising at least 3 printing engines, wherein each adjacent pair of printing engines comprises a first printing station and a second printing station, in accordance with claims 1-28.

30. A method of applying a fine positional correction to a substrate on a tandem printer,
10 comprising:

printing on a substrate by a first printing station;

transferring the substrate from the first printing station toward a second printing station,

comprising:

mounting the substrate on a rotatable element of a substrate-transfer system; and

15 moving the substrate by rotating the rotatable element at a given rotation rate;

measuring the angular position of an edge of the substrate on the rotatable element; and

applying a step angular displacement to the rotatable element, responsive to the measurement, without changing the rotation rate of the rotatable element.

20 31. A method according to claim 30 wherein:

rotating the rotatable element at a given rotation rate comprises rotating the rotatable element by a flexible strip; and

applying the step angular displacement to the rotatable element comprises applying a step displacement to the flexible strip.

25 32. A method according to claim 31 wherein applying the step displacement to the flexible strip comprises any of a positive and negative step displacements to the flexible strip, thus inducing any of a clockwise and a counterclockwise step angular displacements to the rotatable element.

30 33. A method according to claim 32 wherein:

applying the positive step displacement to the flexible strip comprises:

releasing flexible strip slack upstream of the rotatable element; and

taking up flexible strip slack downstream of the rotatable element; and

applying the negative step displacement to the flexible strip comprises:

releasing flexible strip slack downstream of the rotatable element; and

taking up flexible strip slack upstream of the rotatable element.

5 34. A method according to claim 33 and including using a lookup table to calculate a necessary step displacement of the flexible strip in order to achieve a desired step angular displacement of the rotatable element.

35. A method according to any of claims 31-34 wherein the flexible strip is driven by a
10 driving pulley, rotating at a constant rotation rate.

36. A method according to any of claims 31-34 wherein the flexible strip is a timing belt.

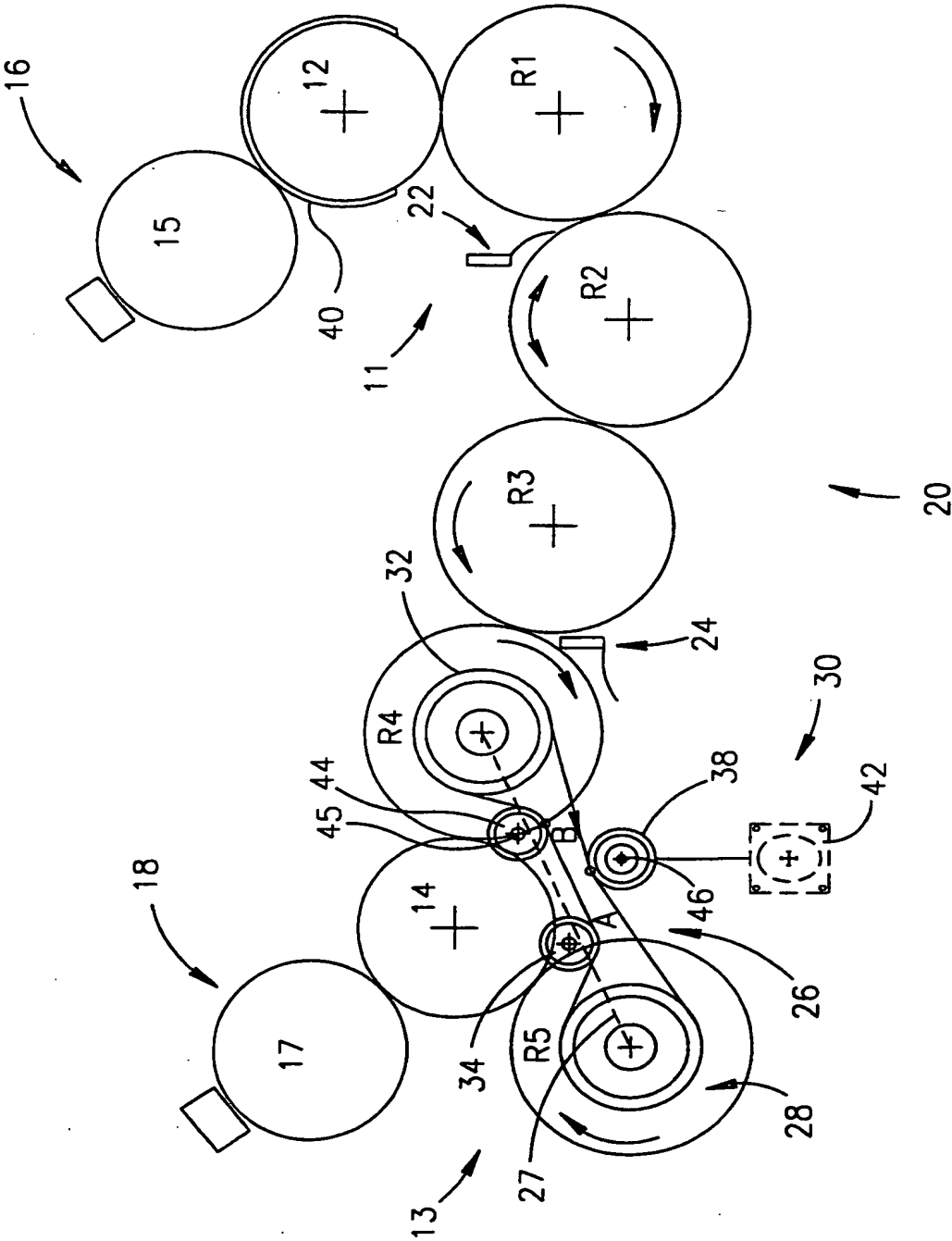


FIG.1

2/2

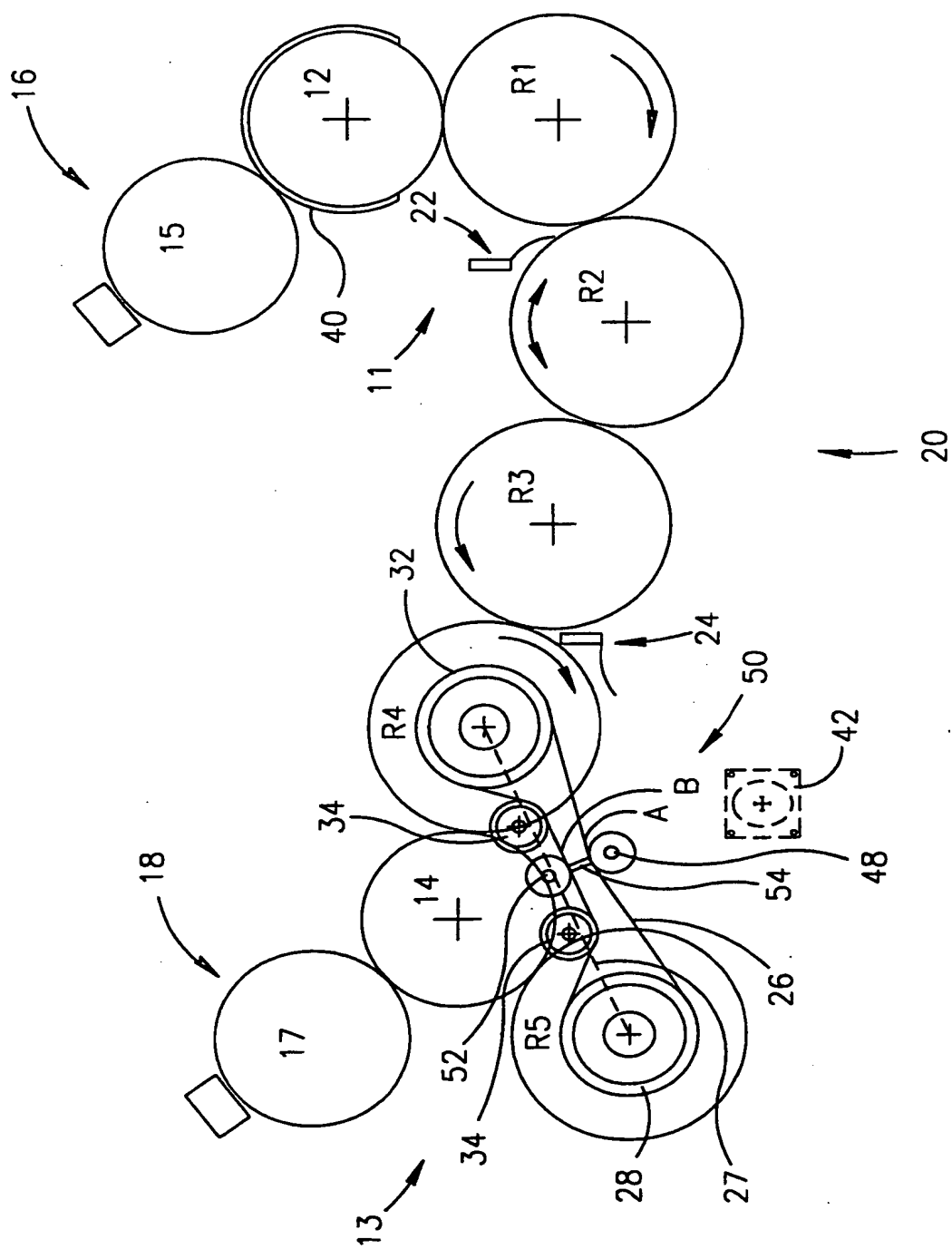


FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/IL 99/00600

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B41F21/12 B41F13/008

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B41F B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 616 886 A (CUIR JEAN PIERRE ; CUIR GERARD (FR)) 28 September 1994 (1994-09-28)	1, 3, 24, 25, 30
Y	column 9, line 17 - line 47; figure 1	4-9, 11, 15, 17, 21, 31-33
X	EP 0 615 941 A (WARD HOLDING CO) 21 September 1994 (1994-09-21)	1, 3, 24, 25, 30
	column 1, line 13 - line 32 column 5, line 17 - line 46; figures 1-4	
Y	US 4 791 869 A (FURUKAWA) 20 December 1988 (1988-12-20)	4-9, 11, 15, 17, 21, 31-33
	the whole document	
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

11 July 2000

Date of mailing of the international search report

19/07/2000

Name and mailing address of the ISA

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Authorized officer

DIAZ-MAROTO, V

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/IL 99/00600

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 861 722 A (HEIDELBERGER DRUCKMASCH AG) 2 September 1998 (1998-09-02)	

INTERNATIONAL SEARCH REPORT

Information on patent family members

national application No

PCT/IL 99/00600

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0616886	A	28-09-1994	FR 2702998 A	30-09-1994
			CN 1099337 A	01-03-1995
			DE 69400007 D	27-07-1995
			DE 69400007 T	14-12-1995
			ES 2076845 T	01-11-1995
			US 5385091 A	31-01-1995
EP 0615941	A	21-09-1994	US 5383392 A	24-01-1995
			DE 69406962 D	08-01-1998
			DE 69406962 T	09-04-1998
			US 5606913 A	04-03-1997
US 4791869	A	20-12-1988	EP 0318605 A	07-06-1989
EP 0861722	A	02-09-1998	DE 19707658 A	03-09-1998
			JP 10235842 A	08-09-1998

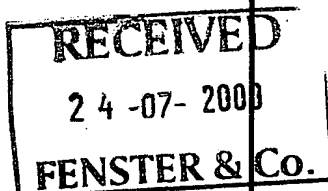
PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

FENSTER & COMPANY PATENT
ATTORNEYS, LTD
Attn. FENSTER, P.
P.O.Box 10256
Petach Tikva 49002
ISRAEL



NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing (day/month/year)	19/07/2000
Applicant's or agent's file reference PDY	FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/IL 99/ 00600	International filing date (day/month/year)
07/11/1999	
Applicant INDIGO N.V. et al.	

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Kenneth Ross
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NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PDY	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/IL 99/ 00600	International filing date (day/month/year) 07/11/1999	(Earliest) Priority Date (day/month/year)
Applicant INDIGO N.V. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

1



None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT 99/00600

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B41F21/12 B41F13/008

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B41F B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 616 886 A (CUIR JEAN PIERRE ; CUIR GERARD (FR)) 28 September 1994 (1994-09-28)	1,3,24, 25,30
Y	column 9, line 17 - line 47; figure 1	4-9,11, 15,17, 21,31-33
X	EP 0 615 941 A (WARD HOLDING CO) 21 September 1994 (1994-09-21) column 1, line 13 - line 32 column 5, line 17 - line 46; figures 1-4	1,3,24, 25,30
Y	US 4 791 869 A (FURUKAWA) 20 December 1988 (1988-12-20) the whole document	4-9,11, 15,17, 21,31-33
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

11 July 2000

Date of mailing of the international search report

19/07/2000

Name and mailing address of the ISA

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Authorized officer

DIAZ-MAROTO, V

INTERNATIONAL SEARCH REPORT

International Application No

PCT 99/00600

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 861 722 A (HEIDELBERGER DRUCKMASCH AG) 2 September 1998 (1998-09-02) -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT 99/00600

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			CN 1099337 A	01-03-1995
			DE 69400007 D	27-07-1995
			DE 69400007 T	14-12-1995
			ES 2076845 T	01-11-1995
			US 5385091 A	31-01-1995

EP 0615941	A	21-09-1994	US 5383392 A	24-01-1995
			DE 69406962 D	08-01-1998
			DE 69406962 T	09-04-1998
			US 5606913 A	04-03-1997

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